



Influence of aerobic exercise on some selected physiological parameters with intervention of diet among type 2 diabetes mellitus male adults

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General Note



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ABSTRACT

Introduction: Studies show that short-term aerobic exercise with diet improves glycemic control and cardiovascular health of patients with type 2 diabetes mellitus (T2DM). Such a study has not been conducted with a diet designed for Saudi residents. The purpose of

the study was to find out the influence of aerobic exercise on some selected physiological parameters with intervention of diet among type 2 diabetes mellitus male adults. *Method:* Twenty patients (mean age (SD) = 41.2 (9.4)) during the year 2019 from the Eastern Province of Saudi Arabia were distributed equally into the intervention and control groups. This was done after excluding patients with chronic diseases, or those who could not come to the study location. The intervention group went through 50-minute exercise sessions (40-90% intensity), three times a week for 12 weeks, and were provided diet recommendations. Control group was not given any specific training. Body mass, body mass index (BMI), total cholesterol, HbA1c, fasting blood glucose and resting heart rate were measured before and after the program. Significant levels were set at 0.05. *Result and Discussion:* Analysis of results after training programs revealed that experimental group had improved in the following variables, as follows; Body mass index of experimental group from pre to post-test with mean and standard deviation were (from 30.68 ± 4.35 to 29.63 ± 4.58 , values, $P < 0.02$), respectively. Total cholesterol changes (from 210.1 ± 29.46 to 167.21 ± 21.19 , values, $P < 0.00$), HbA1c changes (from 8.91 ± 1.28 to 8.08 ± 1.37 , values, $P < 0.00$), Fasting blood glucose changes (from 230.4 ± 90.37 to 210.4 ± 81.45 , values, $P < 0.00$), Resting heart rate improved (from 82.50 ± 4.97 to 73.90 ± 4.62 , values, $P < 0.00$). Moreover, control group had not shown any changes from pre to post - test and all the selected variables were not significant. *Conclusion:* It is concluded that the aerobic training with diet intervention had shown improved performance among type 2 diabetes mellitus male adults with regard to the selected variables, such as; total cholesterol, HbA1c, fasting blood glucose and resting heart rate.

Keywords: Type 2 diabetes, Diet, Aerobics, Glycemic

1. INTRODUCTION

Diabetes Mellitus (DM) cause health problems such as coronary artery disease and crippling of a body part (Al-Nozha et al., 2004). The International Diabetes Federation (2019) estimates that 18.3% of the Saudi population has type 2 DM. Physical activity is beneficial in the treatment of type 2 DM (Colberg et al., 2010). The International Diabetes Federation (2019) estimates diabetes around the globe approximately 463 million adults (20-79 years) were living with diabetes; by 2045 this will rise to 700 million. Adults with type 2 DM patients are recommended to participate in 50 minutes of moderate physical activity three days a week (American Diabetes Association, 2020). Moreover, suggested by (American Diabetes Association, 2020) light walking is a great place to start and a great habit to include into your life. This recommendation is the same for healthy adults (Haskell et al., 2007). Furthermore, training session should minimally include 5 to 10 exercises involving the major muscle groups such as; lower and upper limbs and core muscles and includes 10–15 repetitions to near fatigue per set early in training (Albright et al., 2000). Exercise with diet intervention also improves glycemic control and cardiovascular fitness of type 2 DM patients (Wycherley, Brinkworth, Noakes, Buckley & Clifton, 2008). It should be noted that the dietary recommendations provided for type 2 DM patients (American Diabetes Association, 2020) are general guidelines. National health organizations need to consider the cultural background of patients in order to develop their diet recommendations. For this reason, it will be important to determine if the recommendations made at a national level help improve the health of type 2 DM patients residing in a particular nation. Among Saudi citizens cardio-vascular disease (CVD) threat factors is highly widespread (Ahmed et al., 2017). Interestingly, it is recommended for the persons with type 2 diabetes should undertake at least 150 min/week of moderate to vigorous aerobic exercise three days in a week, with no more than two-consecutive days of aerobic activity (ACSM Diabetes and Exercise Guidelines. Lifestyle interventions incorporating diet with or without exercise increase glycemic control reduce oxidative stress and recover other cardiovascular risk factors in obese subjects with type 2 diabetes (Wycherley et al., 2008).

The purpose of the study was to find out the influence of aerobic exercise on some selected physiological parameters with intervention of diet among type 2 diabetes mellitus male adults.

2. METHOD

Trial Design

The study was a parallel-group randomized control trial conducted during the year 2019 at Dhahran, Eastern Province of Saudi Arabia.

Participants

Thirty men with type 2 DM were selected from hospitals in Dhahran, Khobar, and Dammam, Eastern Province of Saudi Arabia during the year 2019. The sample size was the maximum obtainable from these cities. The selected patients were medically examined at Al Borj medical lab, before the program. Women were not recruited due to cultural limitations in Saudi Arabia. The exclusion criteria

were: (i) Patients with chronic diseases such as retinopathy, neuropathy, asthma, arthritis, morbid obesity and cardiovascular disease, and (ii) Patients who were not able to come to the study location. Twenty men patients passed the screening. The first ten patients who signed the consent form and registered were placed in the intervention group. The patients registered with an administrative staff at the Physical Education Department of KFUPM who was not aware of the research. Patients allocated to the intervention and control groups were informed on separate days about what they needed to do during the 12 weeks. The lab technicians and the statistician were blinded after the assignment to the interventions (figure 1).

Committee Approval

The Research Committee of Physical Education Department, at King Fahd University of Petroleum & Minerals, Saudi Arabia, approved this study, ref ID- PE104-2019. The patients signed a written consent form before the study. The privacy of their results was guaranteed.

Diet Program

The expert Nutritionist facilitated diet program to the participants from KFUPM, Saudi Arabia. The aim of the diet program was to provide the necessary calories to reach and maintain the ideal body weight of the patients. Moreover, participants taught to eat a fixed amount of calories daily for 12 weeks. The diet considered the food preferences and the exercise and drug dosage of the patients. Diet observing achieved by decisive if the patients reached their weekly target in losing bodyweight. Patients who reached their weekly target bodyweight, and maintained their ideal body weight, were motivated by rewards. Participants were conversant of the importance of a diet and exercise in enhancing their health and maintaining glycemic control.

Pilot study

The pilot study was conducted at King Fahd University of Petroleum and Minerals (KFUPM), Eastern Province of Saudi Arabia. The aims of the pilot study were: (i) To determine the appropriate exercise intensity for the program (ii) To determine the duration per exercise session for the patients (iii) To determine the ability of the patients to perform the exercise (iv) To check if the equipment was properly calibrated (v) To check if the treadmills functioned properly, and (vi) To troubleshoot problems before the program began. Four patients who were not part of the study group were chosen for the pilot study.

Exercise Program

The exercise program was conducted at KFUPM and attendance of the participants was taken regularly during the training sessions. The exercise program was employed for 12 weeks, three days in a week, one day on and one day off, 50 minutes of each session. Each participant had an alternate day for training in case they missed the regular training day. The program was supervised by a physical trainer. The patients in the intervention group were given 5 minutes each of warm up and cool down before and after each exercise session respectively. They performed exercises on the treadmill at low exercise intensity (30-40% HR_{max}) for 30-50 minutes during the familiarization period.

The exercise heart rate was measured using the heart rate monitor on the treadmills. The patients were asked not to exceed their target heart rate (THR), which was estimated by using the Karvonen formula (Karvonen & Vuorimaa, 1988):

$$THR = ((HR_{max} - RHR) \times \text{Exercise intensity}) + RHR \quad (1)$$

Where HR_{max} = maximum heart rate and RHR = resting heart rate.

The maximum heart rate was estimated using the Fox, Naughton, and Haskell equation (1971):

$$HR_{max} = 220 - \text{Age} \quad (2)$$

The exercise intensity was increased every four weeks: 40-60% intensity in the first four weeks, 60-70% in the second four weeks, and 70-90% in the last four weeks. The progressive increase in exercise intensity depended on the capability of the patients.

Blood glucose monitoring

Blood glucose levels of the patients were monitored before, during and after each exercise session using the Roche glucometer (Accu-Check Performa). A patient with a blood glucose level less than 70 mg/dL before the exercise drank a juice or ate a snack. A

patient with a blood glucose level of 250 mg/dL will be attended immediately by the diabetic nurse and provides required insulin dosage by Nova Rapid Flex Pen. Patients whose blood glucose dropped to 70 mg/dL, or experienced any symptoms of hypoglycemia during the exercise were asked to stop the exercise. They drank 125 mL of juice which contained 15 g of sugar and resumed the exercise after their blood glucose level increased. In the event of having any patient with blood glucose levels below 70 mg/dL after the exercise, the following was administered: (i) 125 mL of juice for patients with blood glucose levels within 51-69 mg/dL, (ii) one spoon of honey for patients with blood glucose levels within 41-50 mg/dL, and (iii) a glucagon injection for patients with blood glucose levels below 40 mg/dL. Participants blood glucose levels were checked with Accu chek performa glucometer before, during and after training program. Furthermore, the participants was monitored during the exercise session and any symptoms show low glucose level the participants asked to stop the training immediately and check the glucose level and if it is less than 80 mg/dL (Juice 125 ML consists of 15 gram of sugar) will be given or if the blood glucose level is less than 50 mg/dL one table spoon of honey is given or if the blood glucose level is less than 40 mg/dL the nurse will give glucagen injection. Later after 15 minutes, again participant's blood glucose level is checked and if needed again juice or honey is provided.

Selected variables Measurements

Body composition was measured by the simple technique Body mass index (BMI) and resting heart rate score were recorded for (15 seconds x 4) at rest. Total cholesterol, HbA1c, and fasting blood glucose were all measured in mg/dL. Blood samples were taken after a 12-hour fast and measured using Dimension® RxL Max®. These parameters were measured before and after the program.

Data analysis

To compare the mean differences from pre to post-test, mean, standard deviation, and independent t-test was computed by the help of SPSS software. The level of Significant was fixed at 0.05.

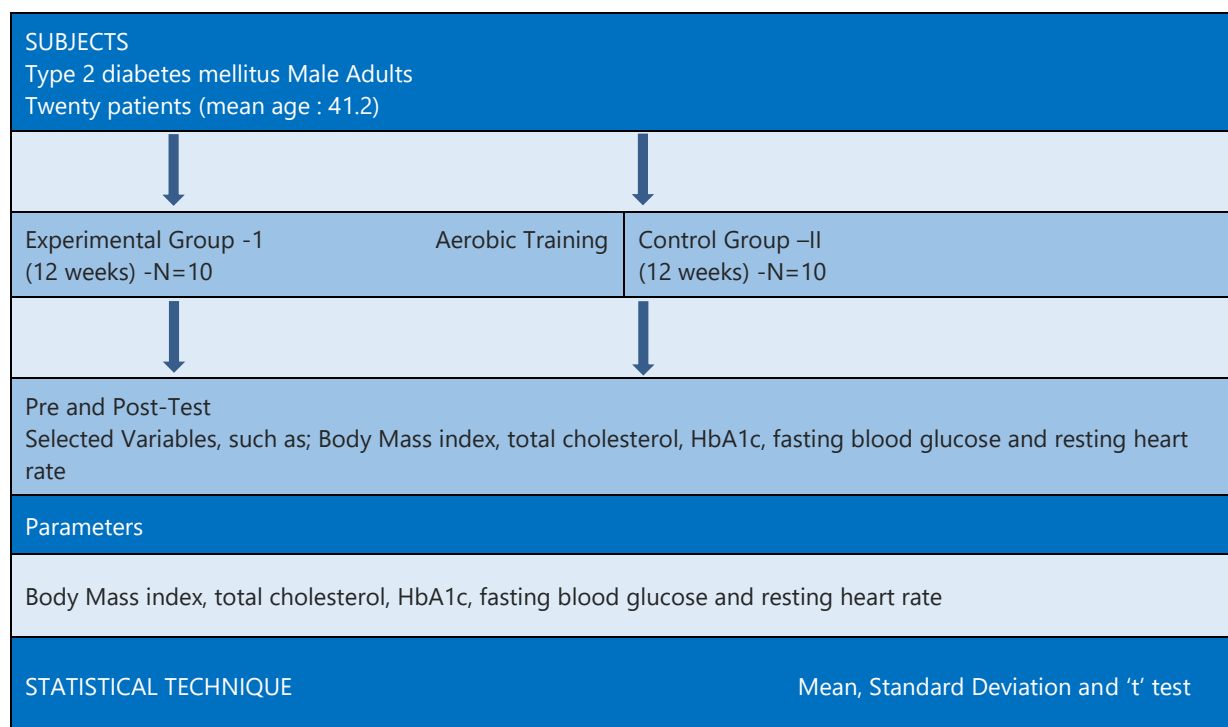


Figure 1 Methodology Flow Chart

3. RESULTS

Twenty patients passed the screening, with 10 patients in the intervention group and 10 patients in the control group. Data from all the patients who were allocated to the intervention (N=10) and the control (N=10) groups were analyzed (table 1).

Experimental Group

Analysis of results after training programs revealed that experimental group had improved in the following variables, as follows; Body mass index of experimental group from pre to post-test with mean and standard deviation were (from 30.68 ± 4.35 to

29.63±4.58, values, $P<0.02$), respectively. Total cholesterol changes (from 210.1±29.46 to 167.21 ±21.19, values, $P<0.00$), HbA1c changes (from 8.91±1.28 to 8.08±1.37, values, $P<0.00$), Fasting blood glucose changes (from 230.4±90.37 to 210.4±81.45, values, $P<0.00$), Resting heart rate improved (from 82.50±4.97 to 73.90±4.62, values, $P<0.00$).

Table 1 speaks about mean, SD and t-test for experimental and Control groups with regard to the selected variables, such as body mass index (BMI), total cholesterol, HbA1c, fasting blood glucose and resting heart rate.

Selected Fitness variables	Experimental N=10 Control N=10	Pre-test		Post test		P Value
		Mean	S.D	Mean	S.D	
Body Mass Index	Experimental	30.68	4.35	29.63	4.58	0.02
	Control	32.79	7.47	33.18	7.10	0.18
Total cholesterol	Experimental	210.1	29.46	167.7	21.19	0.00
	Control	203.2	56.39	206.7	76.86	0.78
HbA1c	Experimental	8.91	1.28	8.08	1.37	0.00
	Control	8.86	1.87	9.45	1.88	0.06
Fasting blood glucose	Experimental	230.4	90.37	210.4	81.45	0.00
	Control	210.0	100.0	239.2	92.10	0.054
Resting heart rate	Experimental	82.50	4.97	73.90	4.62	0.00
	Control	79.50	3.27	80.10	3.38	0.19

Control Group

Analysis of results after training programs revealed that control group had not improved in the following variables, as follows; Body mass index not significant (from 32.79±7.47 to 33.18±7.10, values, $P>0.18$), respectively. Total cholesterol no changes (from 203.2±56.39 to 206.7±76.86, values, $P>0.78$), HbA1c changes (from 8.86±1.87 to 9.45±1.88, values, $P>0.06$), Fasting blood glucose no changes (from 210.0±100.0 to 239.2±92.10, values, $P>0.054$), Resting heart rate not significant (from 79.50±3.27 to 80.10±3.38, values, $P>0.19$) (figure 2).

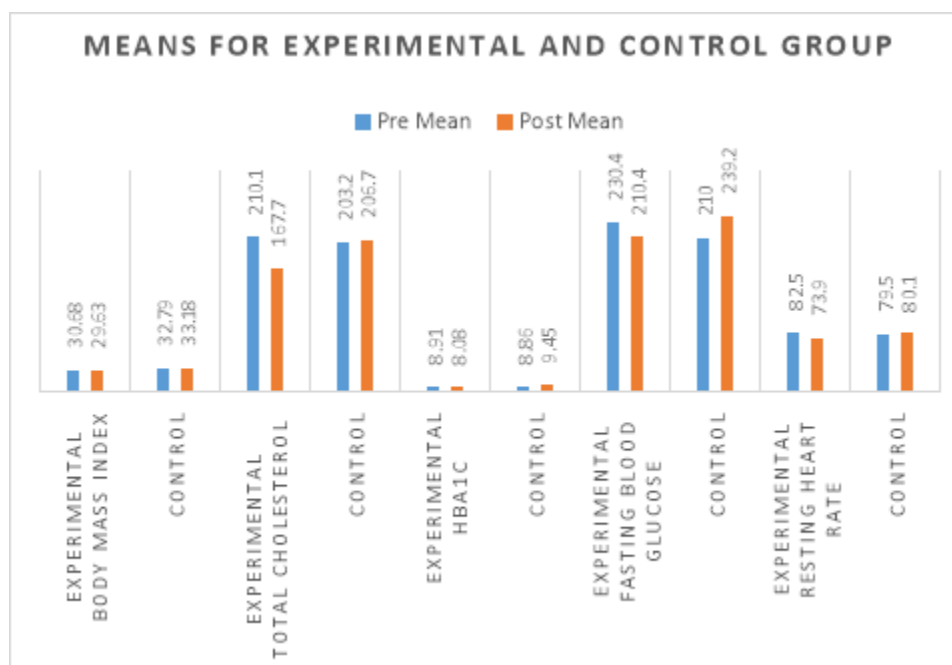


Figure 2 means for experimental and control groups from pre to post-test with regard to the selected variables, such as body mass index (BMI), total cholesterol, HbA1c, fasting blood glucose and resting heart rate.

4. DISCUSSION

The study investigated the effects of a 12-week program consisting of aerobic exercise and diet on the glycemic control and cardiovascular health of men with type 2 DM. The diet was designed specifically for patients residing in Saudi Arabia. The research hypothesis was that the intervention would significantly improve their glycemic control and cardiovascular health. Improvements in HbA1c after 12 weeks from baseline in the intervention group agree with several previous studies (Wycherley et al., 2008). However, there is statistically significant difference between the intervention and control groups in glycemic control after the program. This apart this study is agreement with other studies which show improvements in glycemic control in an exercise-only program (Hashim, & Al-Qahtani, 2013). Reduction in total cholesterol, after 12 weeks from baseline was also noted by Wycherley et al. (2008) and also agreement with the earlier study on combined training protocol on coronary heart diseases variables among morbid obese males had shown significant improvement from pre to post-test (Azeem, 2020). However, there were statistical differences between the groups in these parameters in this study. This is encouraging that the participants had followed the diet plan and had shown encouraging results. As for significant differences between the groups in HbA1c, patients regularly monitor their blood glucose levels before and after meals.

Limitations and recommendations

One limitation is that all the patients were men and the sample size was small. This makes the results not generalizable to all type 2 DM patients. It is recommended that a larger sample size is used for better results.

5. CONCLUSION

It is concluded that the aerobic training with diet intervention had shown improved performance among type 2 diabetes mellitus male adults of intervention group with regard to the selected variables, such as; total cholesterol, HbA1c, fasting blood glucose and resting heart rate. It also revealed that the participants had shown in significant improvement in Body mass index. Moreover, Control group had not shown any improvement from pre to post-test and not all the selected variables were significant. This apart this is evident that the aerobic training for three days in a week for twelve weeks is also effective in enhancing the health among the type 2 diabetes mellitus male adults. This is recommended to the physical trainers, coaches, and fitness professionals to include the aerobic training and diet plan for the patients with type 2 diabetes along with the medicine to manage and control the disease.

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Conflicts of Interest: The authors declare no conflict of interest.

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